



## Expectations from APBON

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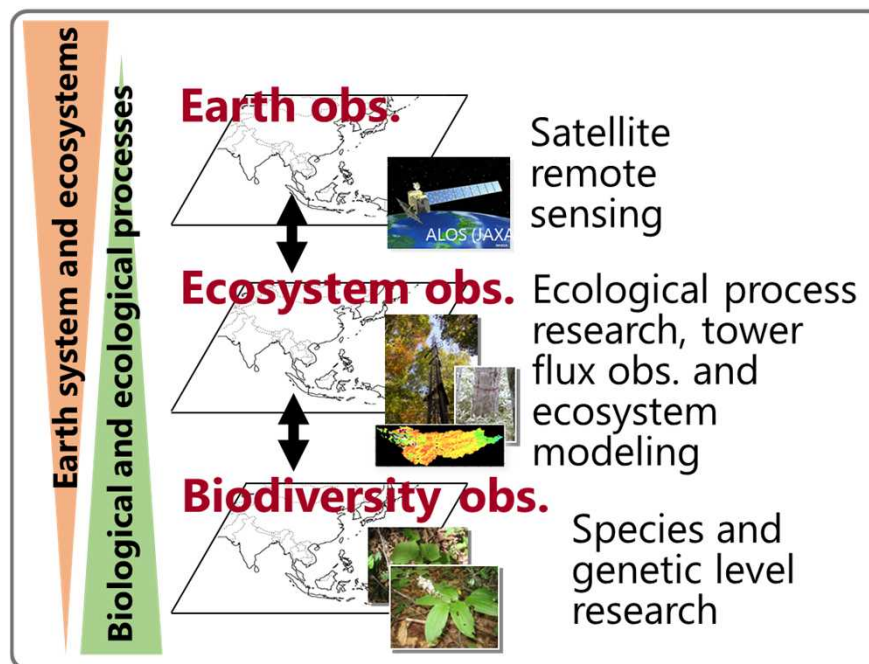
# APBON

## Mission

- 1) Contribution to sound decision making related to biodiversity conservation based on scientific information
- 2) Facilitation of the utilization of existing biodiversity data
- 3) Coordination of a regional network

## Activities

1. Monitoring changes of biodiversity
  - ✓ Biodiversity mapping
  - ✓ Identification of key drivers  
Land use change, Climate change
2. Networking of the observations networks
  - ✓ Sharing information through the networks
3. Capacity building



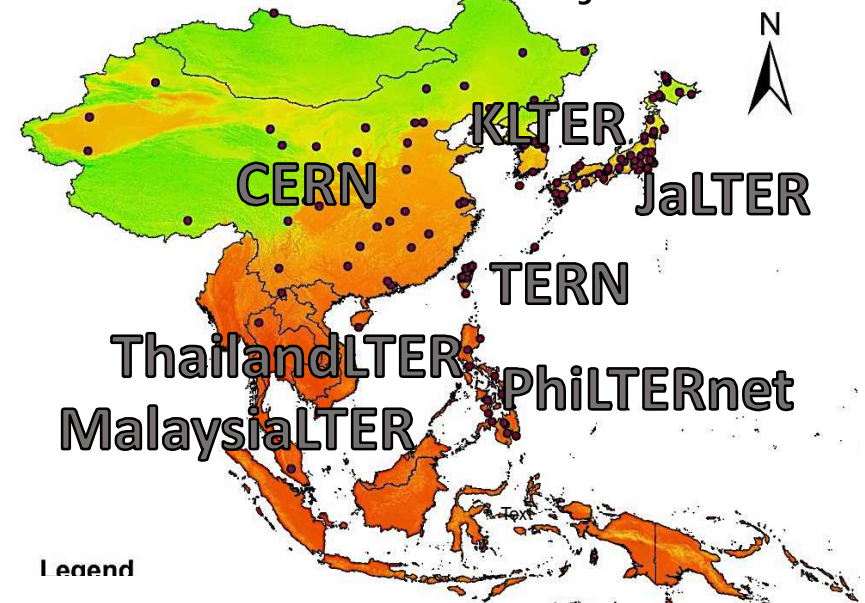
(Muraoka et al. 2012 in APBON book)

# Biodiversity monitoring sites



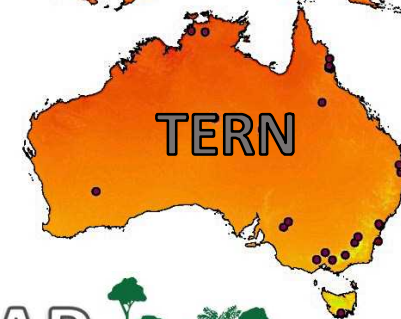
- Terrestrial (85)
- Fresh water (11)
- Marine (20)

## ILTER-EAP East Asia and Pacific region



Legend

8 member networks

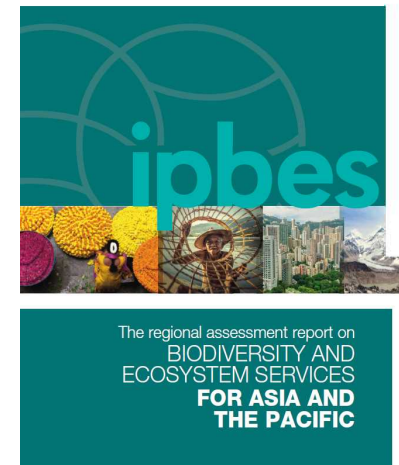
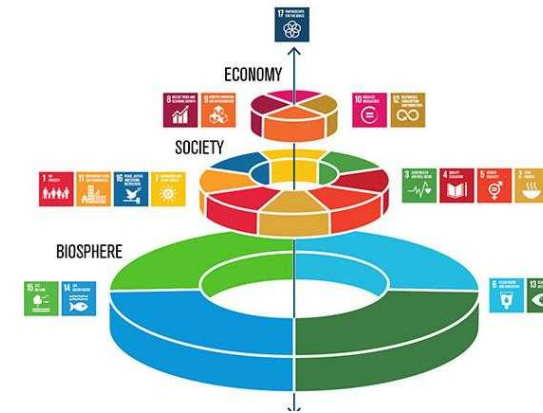


ILTER-EAP



# Vision & Challenges of APBON

- The Earth observation – increasing the societal demand
- APBON will strive to supply the scientific evidence to develop sound assessments and facilitate policy-making
- **Promoting interdisciplinary research and problem-solving approaches with filling the knowledge gaps**
- **Strengthening biodiversity observation networks, collaboration with other TGs.**
- Promoting the data accessibility, deliver our information and knowledge to global platforms such as CBD and IPBES



Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services

- ADVANCE UNEDITED VERSION -

6 May 2019

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The regional assessment report on  
BIODIVERSITY AND  
ECOSYSTEM SERVICES  
FOR ASIA AND  
THE PACIFIC



<https://www.ipbes.net/assessment-reports/>

# Vision & Challenges of APBON

Our challenges include...

## 1. **Scaling-up the observational area**

- Geographical gaps, Temporal gaps
- Scaling-up monitoring of Ecosystem processes/functions

**with Remote sensing team**

## 2. **Understanding relationships between species diversity and ecosystem functions**

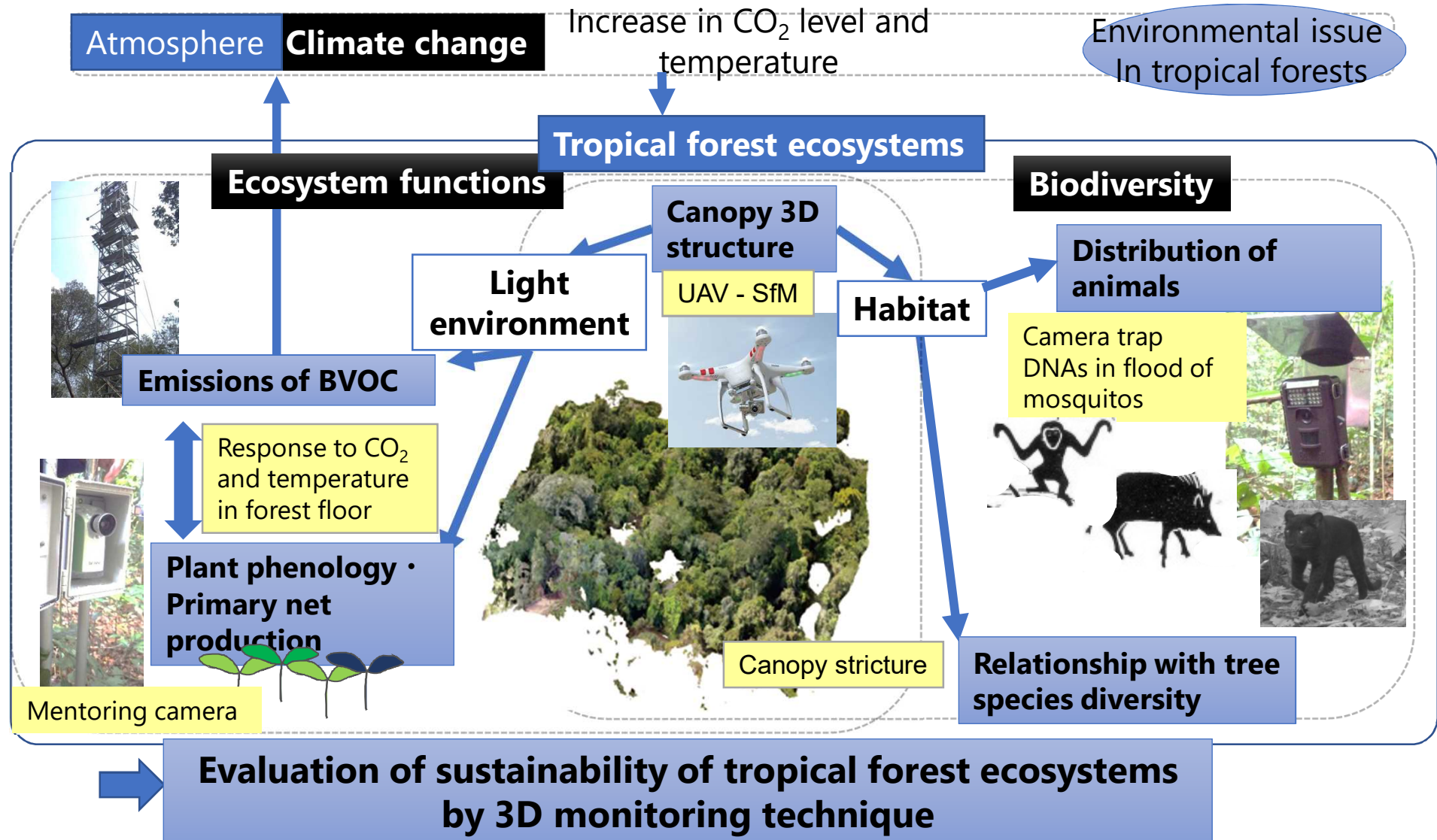
- Species diversity vs Biomass
- Species diversity's contribution to ecosystem services, mitigation of climate change

**with Carbon/GHG TG**

From April 2016- March 2019 (3yrs)

# Development of methodology for species and functional diversity assessment in Southeast Asian tropical forests using high-resolution 3D monitoring technique

~Toward understanding the feedback mechanism of climate change to tropical forest ecosystems~



# Species diversity and canopy structure of a tropical tree community in Malaysia

Yayoi Takeuchi, Habura Borjigin, Nobuko Saigusa (National Institute for Environmental Studies, Japan), Kaoru Niiyama, Tamotsu Sato (Forestry and Forest Products Research Institute, Japan), Toshinori Okuda (Hiroshima University), Hamdan Omar, Azharizan Mohammad Norizan (Forest Research Institute Malaysia)



**“Forest canopy”**

- Major ecological processes
- Major environmental factor
- Forest attributes

# Species diversity influenced by forest structure in finer scale

- 3D-forest structure would be a key for species coexistence

Horizontal  
Structure



Light



Niche

Competition

40  
(a)



Cf. Forest architecture hypothesis (Kohyama 1993)

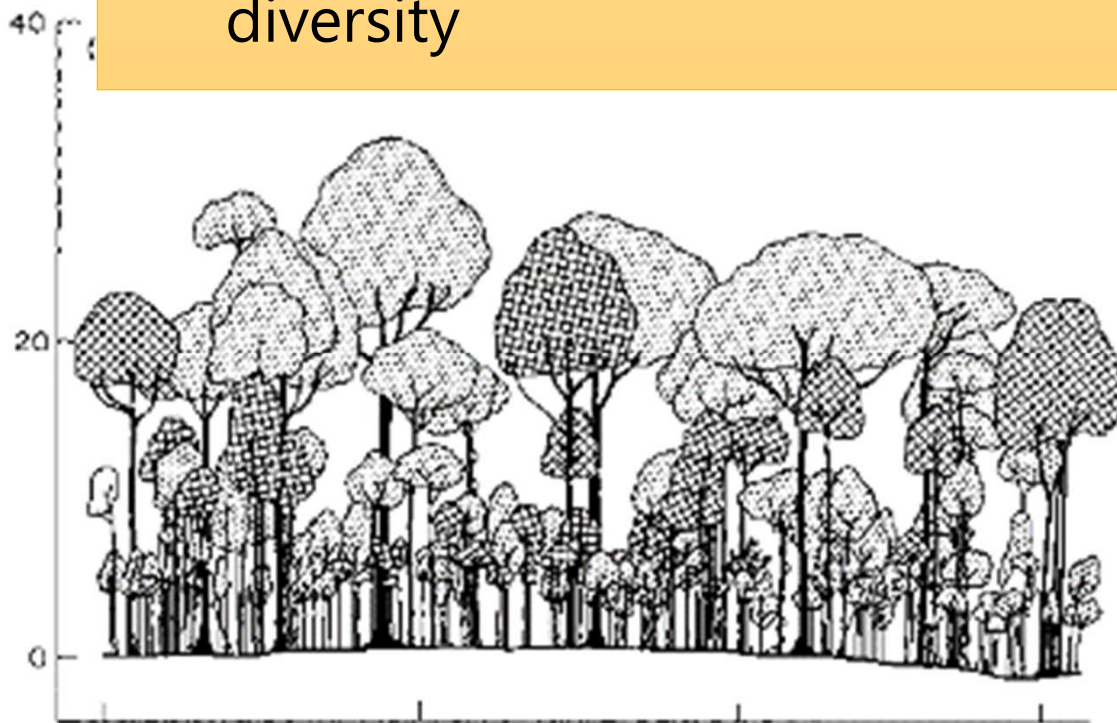
**Taller forest can support more species**



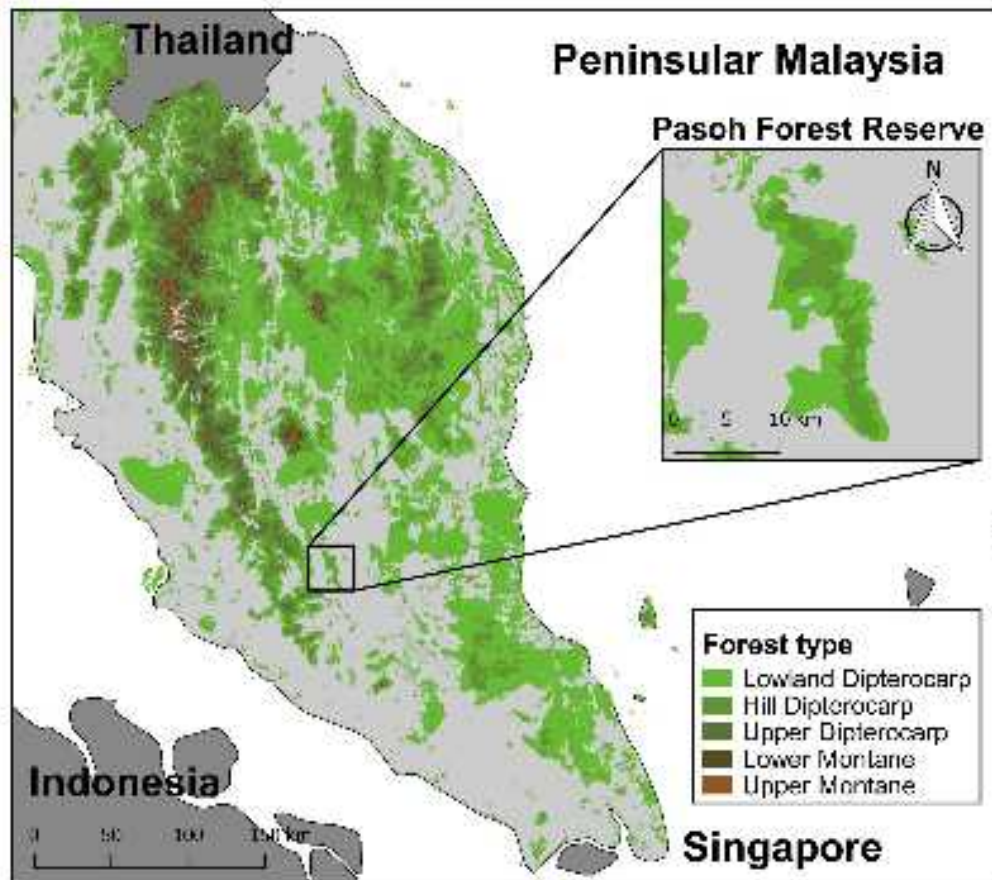
# Objective

To understand the relationship between forest structure and species diversity

- (1) Characterizing forest canopy structure by UAV-SfM
- (2) Exploring forest canopy index which infer tree species diversity



# Pasoh Forest Reserve



50ha plot **CTFS/FRIM, 1987~**

**ILTER-EAP**



6ha plot **FFPRI, 1994~**

Canopy tower  
& walkway

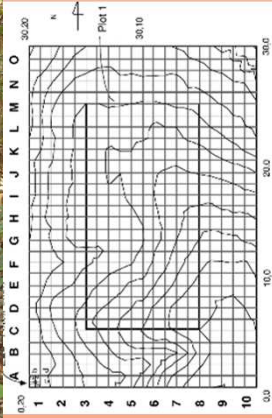


Several 1ha plot **FRIM, 1960s**

# Field Observation & survey



Tree species diversity & size



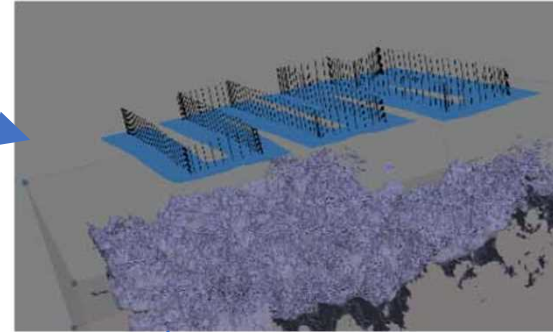
Photos by a UAV



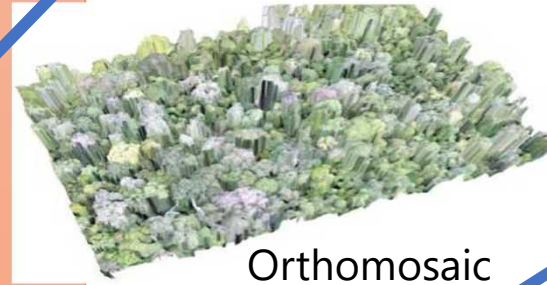
Ground control points



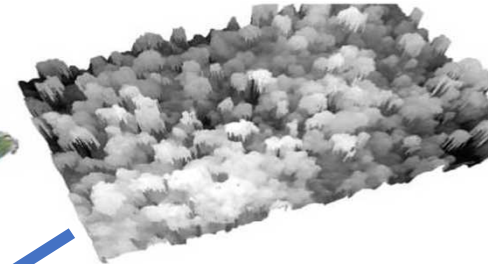
# Computation



Structure from Motion (SfM)

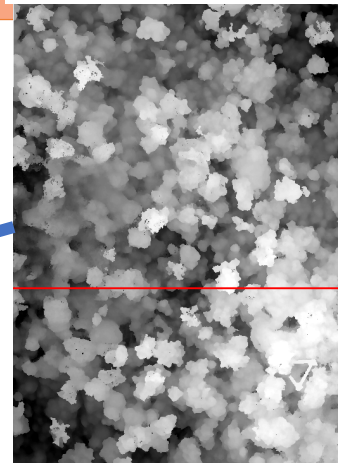


Orthomosaic image



Digital Surface Model (DSM)

Digital Elevation Model (DEM)



Digital Canopy Height Model (DCHM)

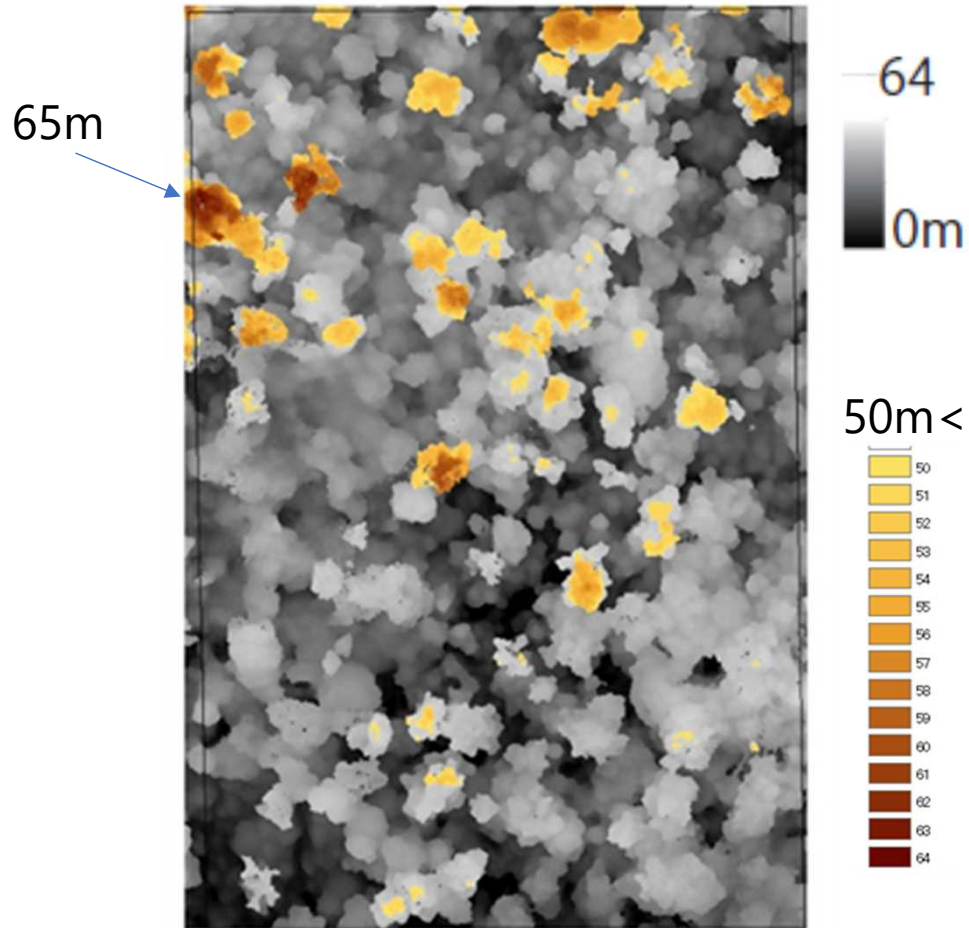


# Statistical Analysis

Species diversity index & Canopy index

# Result

Canopy height

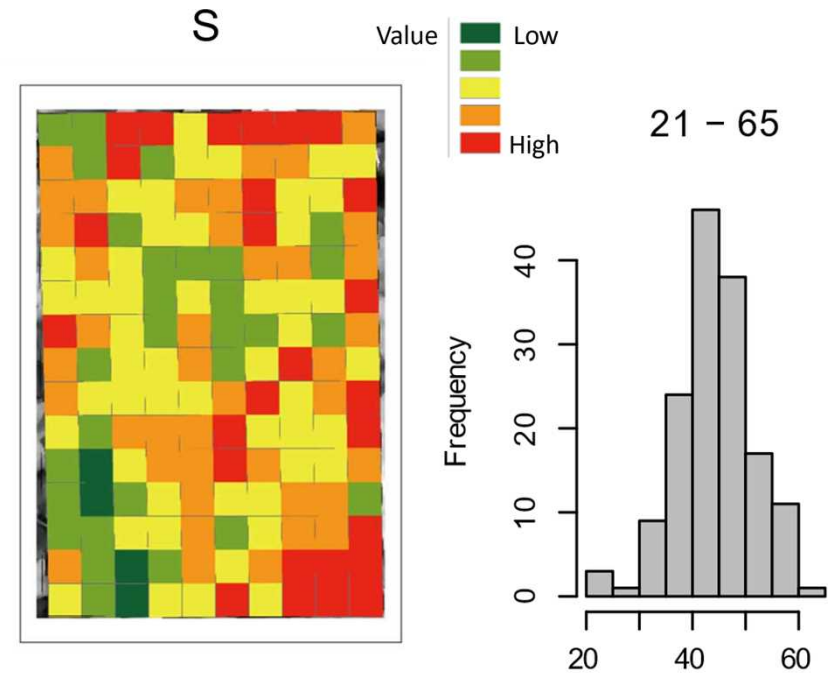
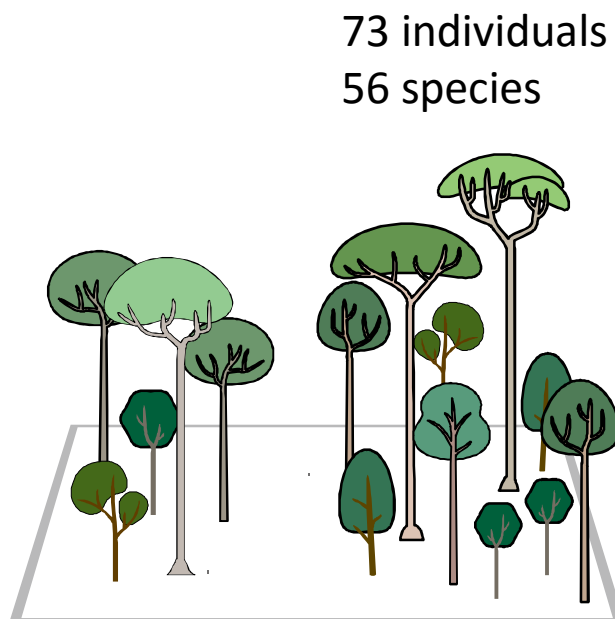


Orthomosaic image



# Species diversity index

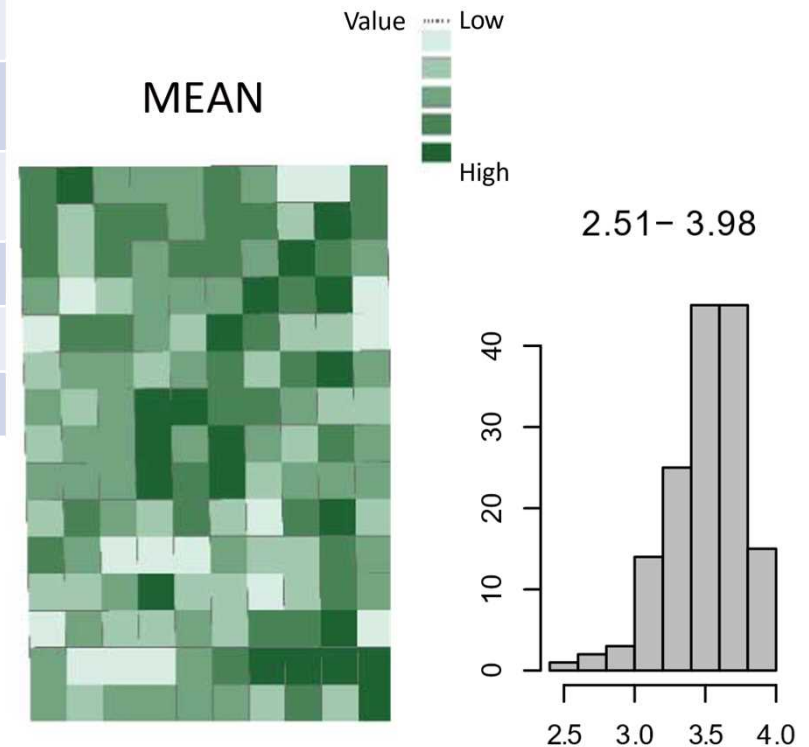
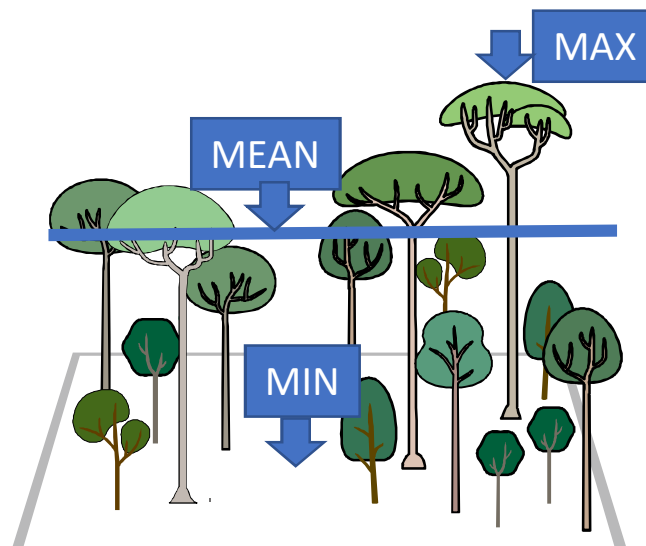
Species diversity index	
S	Species richness
H	Shannon's index
simp	Simpson's index
invsimp	Inverse simpson's index
J	Evenness



20 x 20 m subquadrant

# Canopy structure index

Canopy structure index	
MAX	Maximum height
MIN	Minimum height
RANGE	MAX -Min
MEAN	Mean of canopy height
SUM	Sum of canopy height
STD	Standard deviation of canopy height
tor	Roughness of canopy (3D/2D)



20 x 20 m subquadrant

Application for large-scale biodiversity monitoring using remote sensing

**Satellite**



What is the measurable biodiversity metrics using remote sensing?



**Air**



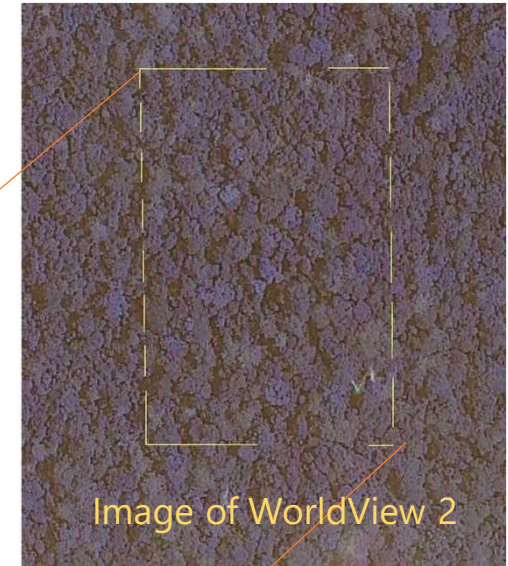
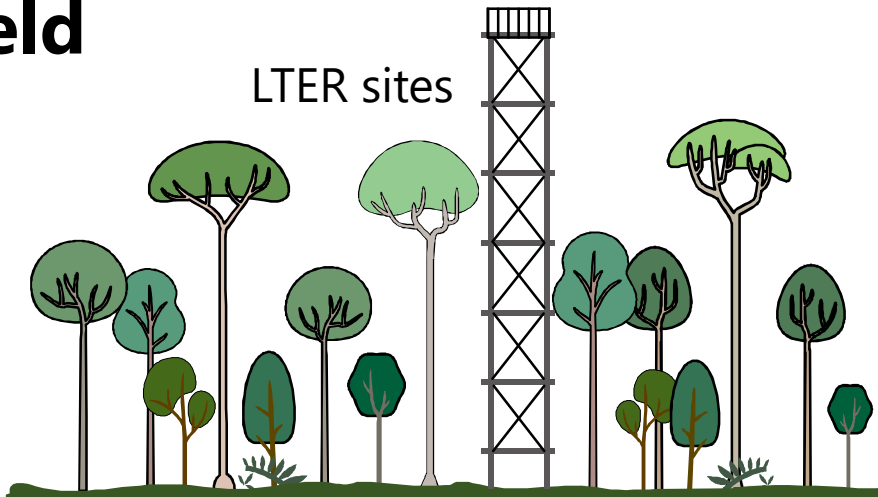
How does Biodiversity relate with Biomass?



Higher species diversity were found in higher canopy

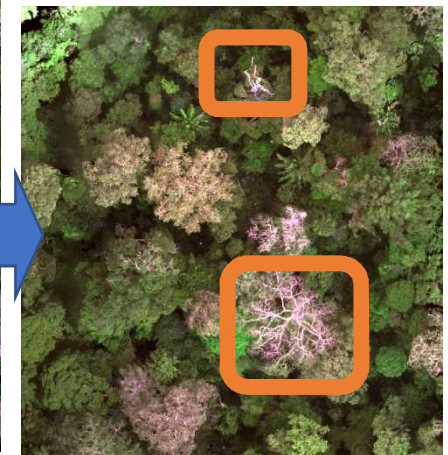
**Field**

LTERR sites



2017

2019



# Phenology as a key ecosystem function

## -Flowering, flushing, coloring leaves

### Ecosystem service

#### Provisioning service

- food production
- raw material

#### Regulating service

- pollination
- carbon storage

#### Cultural service

- recreation/tourism



Buah Engkabang  
The oil-rich city in the sun  
(The encyclopedia of Iban studies, 2001)





# Phenology observation SENTINEL

Seasonal RGB images observed by SENTINEL-2 at Koishikawa Botanical Garden in Tokyo (10m res.)

Satellite

SLATS

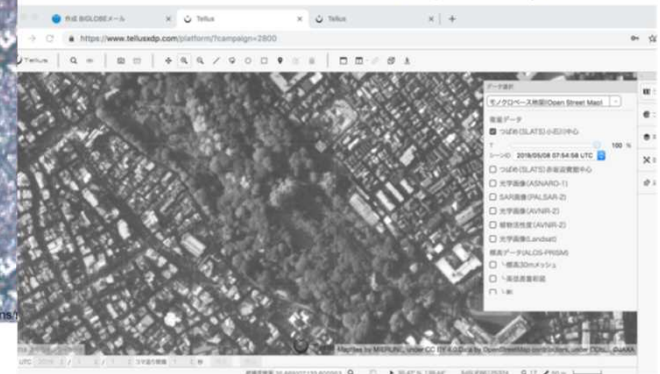
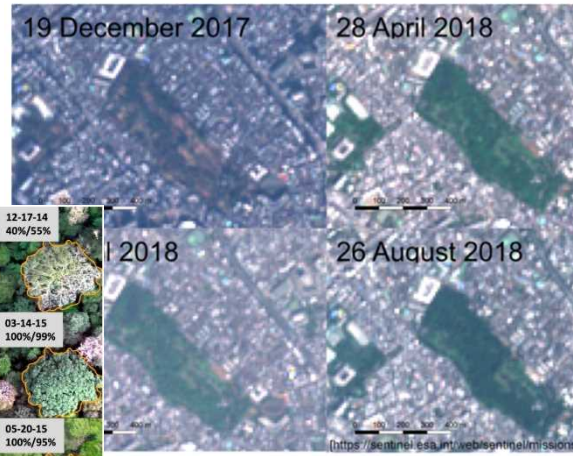
Phenology observations by advanced optical satellites (e.g., SLATS; Tsubame, m resolution)

At Koishikawa Botanical Garden in Tokyo on 8 May 2019

Satellite

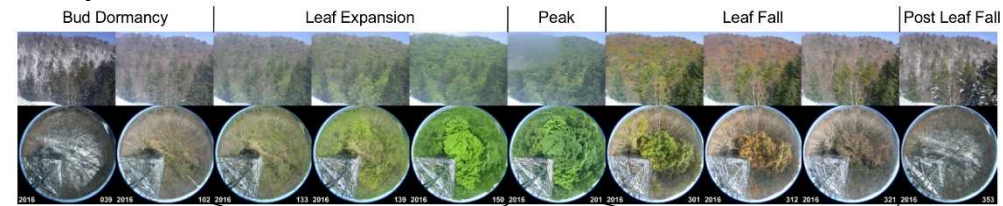


UAV

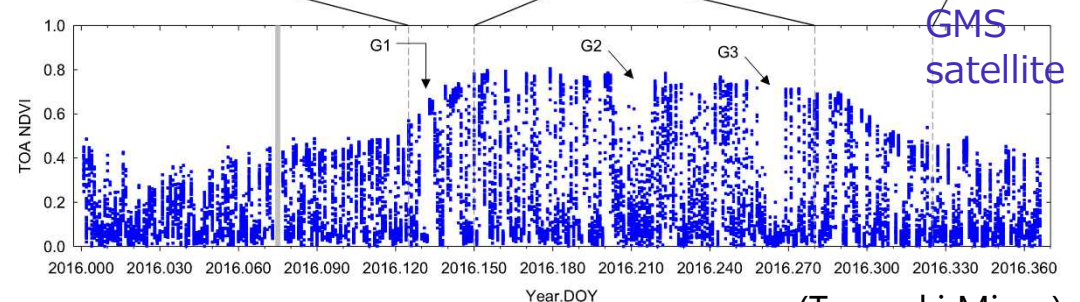
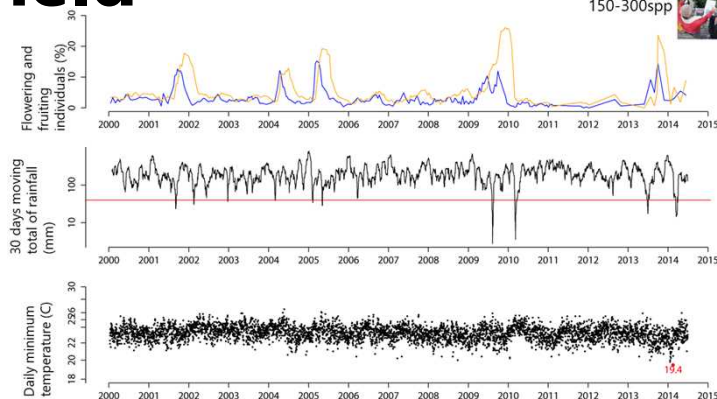


Time-lapse camera

(Shin Nagai)



Field In-situ observation monitoring since 1992 150-300 spp



(Tomoaki Miura)

# Conclusions: Expectations from APBON

1. Filling the observational gaps **through collaboration with Remote sensing team**
  - Geographical gaps, Temporal gaps
  - Scaling-up monitoring of Ecosystem processes/functions
2. Understanding relationships between species diversity and ecosystem functions **through collaboration with Carbon/GHGs TG**
  - Species diversity vs Biomass
  - Species diversity's contribution to mitigation of Climate change

# Expected outcomes

Integrated earth observations will provide the insight for interaction among Essential Variables

APBON's main target



<p><b>Essential Biodiversity Variables</b></p> <ul style="list-style-type: none"> <li>Genetic Composition (10)</li> <li>Species Populations (47)</li> <li>Species Traits (36)</li> <li>Community Composition (41)</li> </ul>	<p><b>Essential Climate Variables</b></p> <ul style="list-style-type: none"> <li><b>Land Cover (81)</b></li> <li>Ecosystem Function (48)</li> <li>Ecosystem Structure (45)</li> <li><b>Above-ground biomass (82)</b></li> <li>Albedo (66)</li> <li><b>Fire (79)</b></li> <li><b>FAPAR (67)</b></li> <li>Glaciers (32)</li> <li>Groundwater (56)</li> <li>Ice sheets and ice shelves (41)</li> <li><b>Lakes (69)</b></li> <li><b>Land surface temperature (72)</b></li> <li>Latent and sensible heat fluxes (45)</li> <li><b>Leaf Area Index (74)</b></li> <li>Permafrost (15)</li> <li>River Discharge (55)</li> <li>Snow (46)</li> <li><b>Soil Carbon (56)</b></li> <li><b>Soil Moisture (65)</b></li> <li><b>Precipitation (surface) (84)</b></li> <li><b>Pressure (surface) (67)</b></li> <li><b>Surface wind speed and direction (72)</b></li> <li><b>Atmospheric temperature at surface (88)</b></li> <li><b>Water vapor (surface) (71)</b></li> <li>Earth radiation budget (upper air) (54)</li> <li>Lightning (36)</li> <li>Temperature (upper air) (44)</li> <li>Water vapor (upper air) (49)</li> <li>Wind speed and direction (upper air) (42)</li> <li>Aerosols properties (50)</li> <li><b>Carbon dioxide, methane and other GHGs (63)</b></li> <li>Cloud properties (38)</li> <li>Ozone (47)</li> <li>Precursors (supporting the Aerosol and Ozone ECVs) (33)</li> </ul>	<p><b>Anthropogenic GHG emissions (55)</b></p> <p><b>Anthropogenic water use (54)</b></p>	<p><b>Anthropic Factors</b></p> <ul style="list-style-type: none"> <li><b>Land use/land use change (84)</b></li> <li><b>Human population (93)</b></li> <li><b>Economic development (81)</b></li> <li><b>Livestock population (73)</b></li> <li><b>Ecosystem/agricultural management (58)</b></li> </ul>
<p><b>Essential Ocean Variables</b></p> <ul style="list-style-type: none"> <li>Particulate Matter (38)</li> <li>Stable Carbon Isotopes (25)</li> <li>Dissolved Organic Carbon (39)</li> <li><b>Fish Abundance and Distribution (53)</b></li> <li><b>Zoo- (44) and Phytoplankton (48) Biomass and Diversity</b></li> <li>Marine turtle, bird and mammal abundance (47)</li> </ul>	<ul style="list-style-type: none"> <li><b>Ocean Surface Heat Flux (50)</b></li> <li><b>Sea Level (84)</b></li> <li><b>Sea Surface Temperature (85)</b></li> <li>Sea State (55)</li> <li>Sea Surface Salinity (66)</li> <li>Sea Ice (49)</li> <li>Subsurface Currents (32)</li> <li>Subsurface Salinity (52)</li> <li>Subsurface Temperature (57)</li> <li>Surface Stress (47)</li> <li><b>Inorganic Carbon (54)</b></li> <li>Nitrous Oxide (45)</li> <li><b>Nutrients (56)</b></li> <li>Ocean Color (65)</li> <li>Oxygen (68)</li> <li>Transient Tracers (18)</li> <li><b>Marine Habitat Properties (57)</b></li> <li><b>Plankton (50)</b></li> </ul>	<ul style="list-style-type: none"> <li><b>Net radiation (SW/LW) at surface (73)</b></li> <li>Below-ground biomass (44)</li> <li><b>Natural GHG flux</b> <ul style="list-style-type: none"> <li>CO<sub>2</sub> (55)</li> <li>N<sub>2</sub>O (48)</li> <li>CH<sub>4</sub> (51)</li> </ul> </li> </ul>	<p><b>Other Variables</b></p> <ul style="list-style-type: none"> <li><b>Topography (84)</b></li> <li>Surface roughness (60)</li> <li><b>Crop yield (78)</b></li> <li>Ground/soil heat flux (48)</li> <li><b>Soil type (75)</b></li> <li><b>Soil quality/health (58)</b></li> <li>Dissolved organic (30) and inorganic (26) carbon (terrestrial)</li> <li>Atmospheric /Planetary Boundary Layer (21)</li> <li>Atmospheric nitrogen deposition (39)</li> <li><b>Infiltration (hydrology) (45)</b></li> <li><b>Runoff (hydrology) (54)</b></li> </ul>

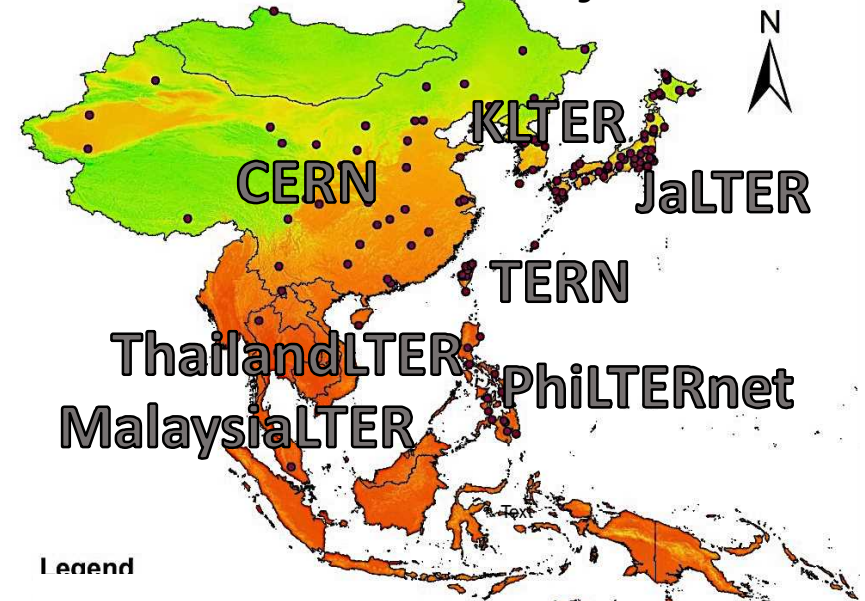
Figure 3. Indicative list of all candidate variables proposed and their assessment score (in parentheses) resulting from the consultative rating process. The preliminary set of 'essential variables' is highlighted in bold font.

# Use our biodiversity observation network



- Terrestrial (85)
- Fresh water (11)
- Marine (20)

## ILTER-EAP East Asia and Pacific region



ILTER-EAP



# BON in “master sites”

Synonyms: “top sites”, “super sites”, “LTER hubs”, “sentinel sites” etc.

	<b>UNESCO BR</b>	<b>Forest GEO</b>
Japan	Yakushima	
Korea	Jeju Island	
China	Xishuangbanna	Xishuangbanna
Taiwan		Lienhuachih
Vietnam	Langbian	Bidoup
Laos		
Cambodia	Tonle Sap	
Thailand	Mae Sa-Kog Ma	Doi Inthanon
Myanmar	Inlay Lake	
Malaysia	Crocker Range	Pasoh, Lambir
Brunei		Kuala Belalong
Singapore		Bukit Timah
Indonesia	Cibodas	
Phillipines	Pallawan	Palanan



Thank you for  
your attention!

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